Appendix G

System for the Analysis of Global Energy Markets (SAGE)

The projections of world energy consumption appearing in this year's *International Energy Outlook* (*IEO*) are based on the Energy Information Administration's (EIA's) new international energy modeling tool, System for the Analysis of Global Energy markets (SAGE). SAGE is an integrated set of regional models that provide a technology-rich basis for estimating regional energy consumption. For each region, reference case estimates of 42 end-use energy service demands (e.g., car, commercial truck, and heavy truck road travel; residential lighting; steam heat requirements in the paper industry) are developed on the basis of economic and demographic projections. Projections of energy consumption to meet the energy demands are estimated on the basis of each region's existing energy use patterns, the existing stock of energy-using equipment, and the characteristics of available new technologies, as well as new sources of primary energy supply.

Period-by-period market simulations aim to provide each region's energy services at minimum cost by simultaneously making end-use equipment and primary energy supply decisions. For example, in SAGE, if there is an increase in residential lighting energy service, either existing generation equipment must be used more intensively or new equipment must be installed. The choice of generation equipment (type and fuel) incorporates analysis of both the characteristics of alternative generation technologies and the economics of primary energy supply.

Although the modeling system used to develop the projections has changed, this year's *IEO* maintains the same level of fuel detail and the same tabular format. As in the past, the *IEO* provides projections of total world primary energy consumption, as well as projections of energy consumption by primary energy type (oil, natural gas, coal, nuclear, and hydroelectric and other renewable resources) and projections of net electricity consumption. Projections of carbon dioxide emissions resulting from fossil fuel use are also provided. All projections are computed in 5-year intervals through the year 2025. Further, more detailed tables that emphasize the end-use demand-driven nature of SAGE will be considered for future reports.

SAGE provides projections for 15 regions or countries, including the North American countries of the United States, Canada, and Mexico; Western Europe; Japan; Australia/New Zealand; Eastern Europe; the former Soviet Union (FSU); China; India; South Korea; other developing Asia; the Middle East; Africa; and Central and South America. An offline procedure is used to develop projections for individual countries that fall into the SAGE regions, including the United Kingdom, France, Germany, Italy, and the Netherlands in Western Europe; Russia in the FSU; Turkey in the Middle East; and Brazil in Central and South America.

Projections of world oil prices over the forecast horizon are provided to SAGE from EIA's International Energy Module, which is a submodule of the National Energy Modeling System (NEMS). Projections of world nuclear energy consumption are derived from nuclear power electricity generation projections from EIA's International Nuclear Model (INM), PC Version (PC-INM). All U.S. projections are taken from EIA's *Annual Energy Outlook* (*AEO*).

A full description of the SAGE model is available in a two-volume set. The first volume provides a general understanding of the model's design, theoretical basis, necessary user-defined assumptions, and output. It also lists the software necessary to develop and analyze the results of SAGE-based policy and energy market scenarios. In addition, Volume I includes a Reference Guide, which explains each equation in detail. The second volume serves as a User's Guide for those actively developing SAGE-based scenario analyses. The documentation is available on EIA's web site in the model documentation section of "Current Publications" (http://www.eia.doe.gov/bookshelf/docs.html).